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Combination of RCRA Groundwater Monitoring Activities for the 216-A-36B, 216-A-10, and 216-A-37-1 Cribs

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Abstract:

This paper proposes to combine and integrate RCRA groundwater monitoring activities for the 216-A-36B, 216-A-10, and 216-A-37-1 Cribs in the 200 East Area south of the Plutonium-Uranium Extraction (PUREX) Plant. The primary reasons for this position paper are: (1) to address RCRA groundwater monitoring requirements at the 216-A-37-1 Crib; and (2) to propose an alternative groundwater program that deviates from the current unit-specific approach. An assessment-level monitoring program using 10 existing wells and one new well is proposed.

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Combination of RCRA Groundwater Monitoring Activities for the 216-A-36B, 216-A-10, and 216-A-37-1 Cribs

Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

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EXECUTIVE SUMMARY

This paper proposes to combine and integrate *Resource Conservation and Recovery Act of 1976* (RCRA) groundwater monitoring activities for the 216-A-36B, 216-A-10, and 216-A-37-1 Cribs in the 200 East Area south of the Plutonium-Uranium Extraction (PUREX) Plant. The primary reasons for this position paper are as follows:

- Address RCRA groundwater monitoring requirements at the 216-A-37-1 Crib
- Propose an alternative groundwater monitoring program that deviates from the current unit-specific approach.

An assessment-level monitoring program is proposed. The proposed network will include approximately 10 existing wells and 1 new well (compared to 23 unit-specific wells). The goal of this monitoring program will be to assess the concentration, rate, and extent of contamination that has originated from this specified waste management area. The monitoring program will also evaluate common contaminants from non-RCRA facilities within the waste management area, because the sources of the contamination cannot be precisely determined. The proposed network will reduce redundancy associated with a unit-specific monitoring approach, while complying with the intent of RCRA regulations. The proposed approach relies on process knowledge and a good historical groundwater database that will maximize interpretation of groundwater impacts and allow a less restrictive and more accurate understanding of groundwater conditions. A preliminary cost-benefit analysis indicates that one combined monitoring network would cost only one-third as much as three unit-specific networks. A RCRA groundwater monitoring plan to combine the RCRA groundwater monitoring networks for the 216-A-10, 216-A-36B, and 216-A-37-1 Cribs will be submitted to the U.S. Department of Energy, Richland Operations Office if this proposal is accepted.

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1.0 INTRODUCTION

This paper proposes to combine and integrate *Resource Conservation and Recovery Act of 1976* (RCRA) groundwater monitoring activities for the 216-A-36B, 216-A-10, and 216-A-37-1 Cribs in the 200 East Area south of the Plutonium-Uranium Extraction (PUREX) Plant. The primary reasons for this position paper are as follows.

- Address RCRA groundwater monitoring at the 216-A-37-1 Crib (Wyer 1995)
- Propose an alternative groundwater monitoring program that deviates from the current unit-specific approach.

This plan supports the U.S. Department of Energy's (DOE) future groundwater program consolidation efforts. The consolidation of these monitoring networks will reduce redundancy and also reduce monitoring costs by more than two-thirds by using a more efficient, revised network to monitor and assess groundwater conditions for the three facilities.

The subject facilities have been grouped together based on the following characteristics:

- Their proximity to one another
- Similar design and waste history
- Their similar hydrogeologic regime.

Adjacent facilities were excluded for specific reasons. The A-AX Tank Farms contained waste with unknown groundwater impact, B Pond system is an active site with a different hydrologic regime, and the 216-A-29 Ditch received waste of a different composition from the grouped sites.

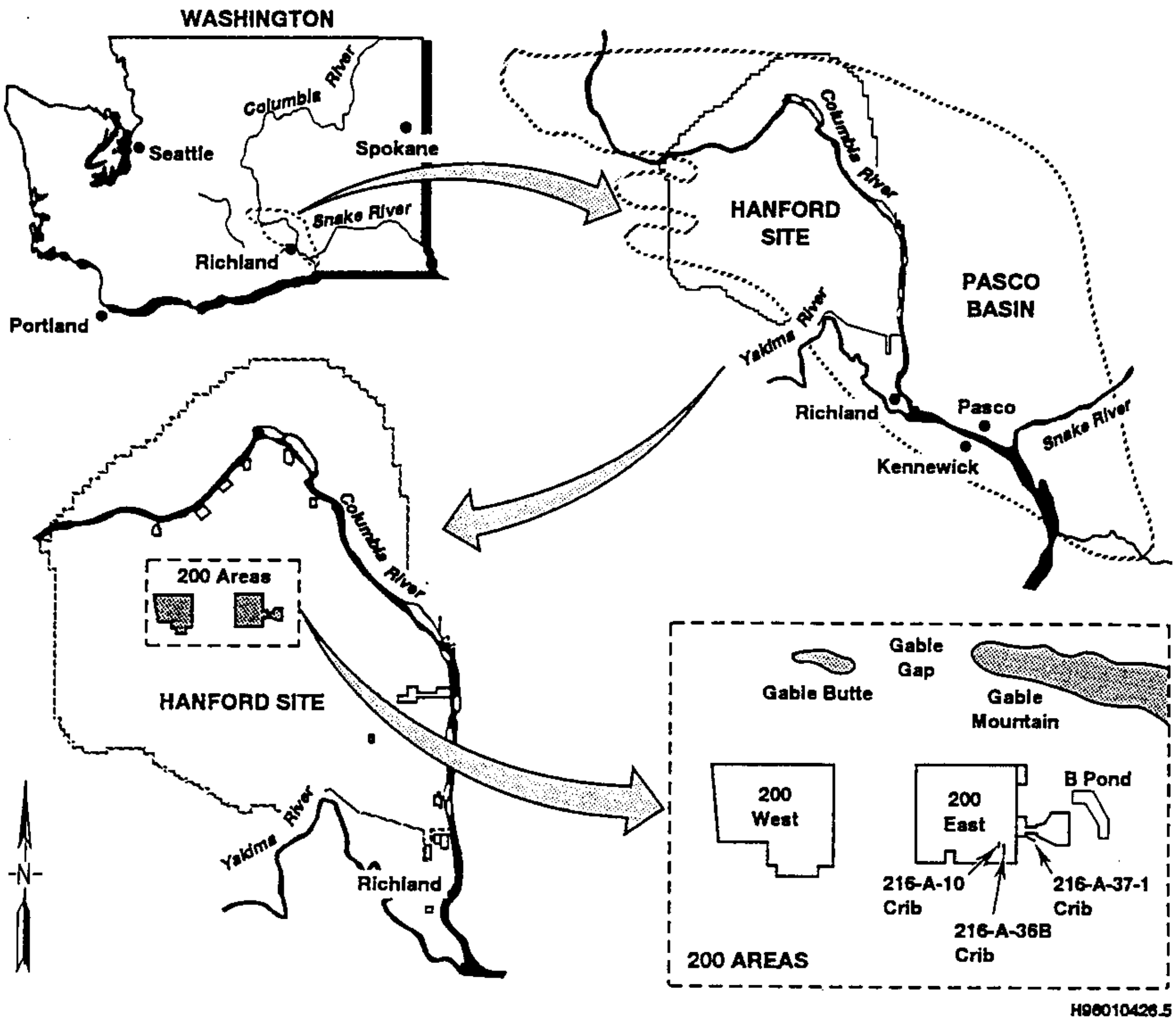
The location and facility descriptions, as well as a description of the hydrogeologic setting of the 200 East Area south of the PUREX Plant, are outlined in the following sections. An assessment-level monitoring program is proposed. The proposed network will include approximately 10 existing wells and 1 new well. The goal of this monitoring program will be to assess the concentration, rate, and extent of contamination that has originated from this specified waste management area (WMA).

2.0 LOCATION AND FACILITY DESCRIPTIONS

The Hanford Site is located in south-central Washington State approximately 170 miles east of Seattle and 130 miles southwest of Spokane (Figure 1). The Hanford Site was initially established in 1943 by the U.S. Army Corps of Engineers as the location for plutonium production reactors and associated plutonium extraction facilities.

The proposed WMA is located mostly in the southeast corner of the 200 East Area and partially in the 600 Area outside the 200 East Area fence. It is the area including and southwest of the 216-A-37-1 and 216-A-37-2 Cribs,

Figure 1. Location of the Hanford Site.



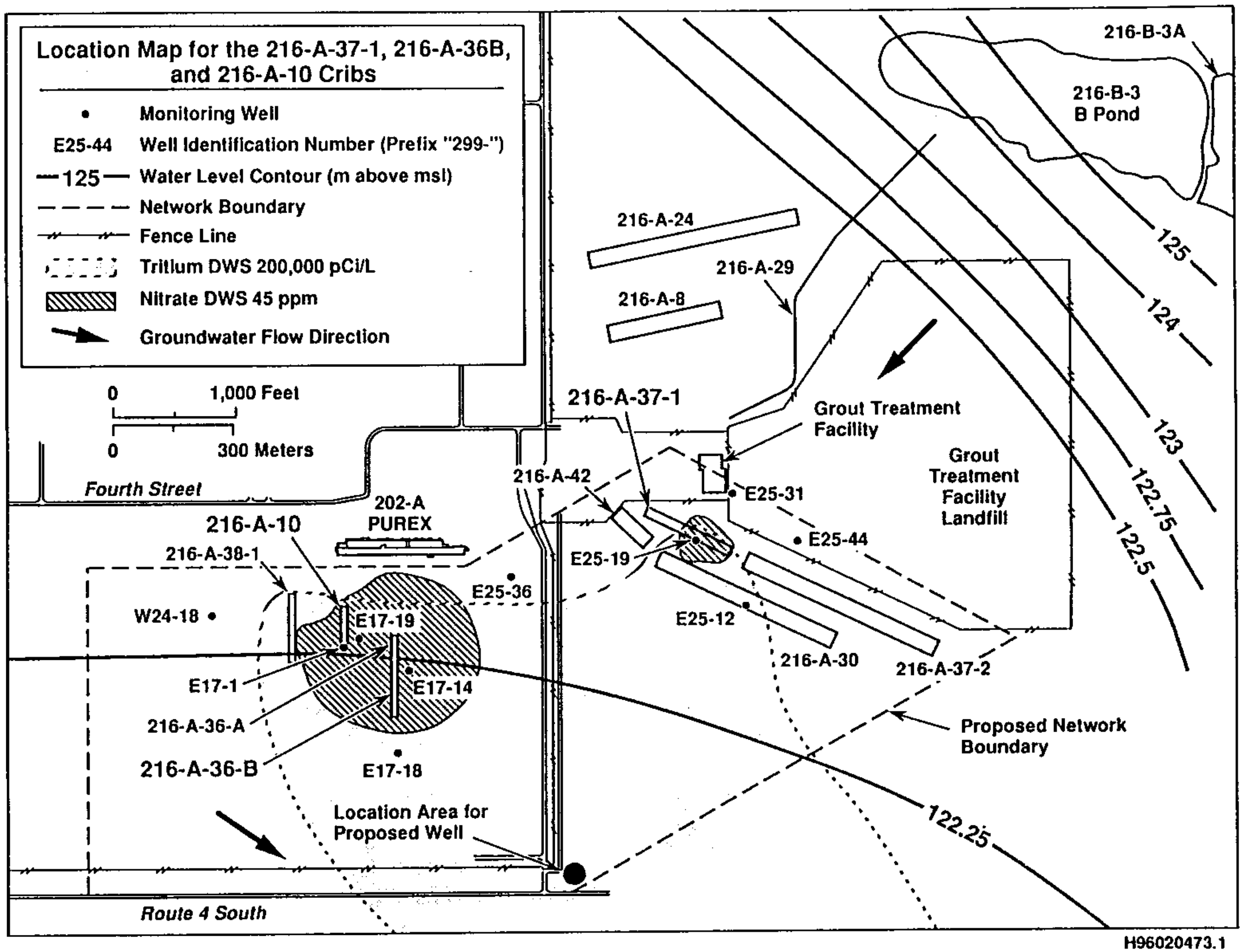


Figure 2. Location of the 216-A-10, 216-A-36B, and 216-A-37-1 Cribs and Other Facilities.

south of the PUREX Plant, east of the 216-A-10 Crib, and north of Route 4 South (Figure 2). The northern and eastern boundaries of the WMA were chosento reflect groundwater flow directions, i.e., from the north and northeast. The boundaries of the proposed WMA will be refined by the hydrogeological conditions that control contamination transport. This includes groundwater flow in and out of the area, preferential plume migration pathways, and geologic controls on the unconfined aquifer system. This WMA will focus on semiregional conditions near the facilities. More extensive regional plume delineation will be achieved by supplementing RCRA data with data from the Pacific Northwest National Laboratory's (PNNL) sitewide groundwater surveillance program.

2.1 SUBJECT AND ADJACENT FACILITIES

The 216-A-10, 216-A-36B, and 216-A-37-1 Cribs adjoin several other liquid waste disposal sites associated with past PUREX operations and related facilities near the southeast corner of the 200 East Area (Figure 2). Other disposal sites located near the subject cribs include the 216-A-29 Ditch, the former Grout Treatment Facility, 6 cribs, the B Pond system, and a retention basin (Table 1). Many of these facilities received effluent that was similar to that discharged to the subject cribs. A physical description of the subject cribs, their operating histories, effluent characteristics, and current monitoring status are included in the following paragraphs.

Table 1. Selected Waste Disposal Facilities Located near the A-10, A-36B, and A-37-1 Cribs [Environmental Sites Database (formerly Waste Information Data System)].

Site Name[a]	Dates used	Waste volume (L)	Waste description
B-Pond (RCRA) System	1945-present[b]	2.4×10^{11}	B Plant cooling water, PUREX chemical sewage, steam condensate (mixed waste).
A-6 Crib	1955-1970	3.4×10^{9}	PUREX steam condensate, floor drainage, storage basin overflow (mixed waste).
A-8 Crib	1955-1991	1.2×10^{9}	Condensate from waste storage tanks, condenser cooling water (low-level waste).
A-24 Crib	1958-1966	8.2×10^{8}	Condensate from waste storage tanks (low-level waste).
A-29 Ditch (RCRA)	1955-1991	not available	chemical sewer waste from PUREX-demineralizer wastes (corrosive, possibly hazardous)
A-30 Crib	1961-1992	7.1×10^{9}	PUREX steam condensate, floor drainage, storage basin overflow (low-level and nitrate)
A-37-2 Crib	1983-1992	1.09×10^{9}	PUREX steam condensate (low-level radioactive)
A-38-1 Crib	Never used	0	Intended to receive liquid waste discharged to A-10 Crib.
A-42 Retention Basin	1978-present	not available	Diversions from PUREX chemical sewer, cooling water, and steam condensate (mixed waste). Treated, discharged to other facilities.

Table 1. Selected Waste Disposal Facilities Located near the A-10, A-36B, and A-37-1 Cribs [Environmental Sites Database (formerly Waste Information Data System)].

Site Name[a]	Dates used	Waste volume (L)	Waste description
Grout Treatment Facility (formerly RCRA)	never used; Grout Project canceled in 1994.	0	Mixed wastes were to be blended into a slurry and poured into underground vaults for storage; however, site was never used.

[a] All site names except Grout Facility are prefixed by 216-. Sites are not RCRA regulated unless noted.
[b] B Pond comprises a main pond and three lobes: A, B, and C. Only C lobe is currently active.

2.2 CRIB DESCRIPTIONS

2.2.1 216-A-36B Crib

The 216-A-36B Crib (A-36B Crib), now retired from use, was a liquid waste disposal facility for the PUREX Plant. The A-36B Crib is located in the 200 East Area approximately 360 m south of the PUREX Plant. It is approximately 110 m east of the 216-A-10 Crib. The A-36B Crib is the south 150 m of the crib, which was originally known as the 216-A-36 Crib (see Figure 2).

The original crib dimensions were 180 m long, 4 m wide, and 4 m deep. A 0.15-m-diameter perforated distributor pipe was placed at the bottom of the crib on a 0.3-m bed of gravel, covered with another 0.3 m of gravel, and backfilled to grade. Ammonia scrubber distillate waste from the PUREX Plant was discharged through the distribution pipe to the crib and allowed to percolate through the soil column.

The original crib (216-A-36) received liquid effluent from September 1965 to March 1966. A substantial inventory of radionuclides was disposed of and assumed to have infiltrated sediments near the inlet to the crib. To continue effluent discharge to the crib, it was divided into two sections: 216-A-36A and 216-A-36B. Grout was injected into the gravel layer to form a barrier between the two sections. The liquid effluent discharge point was moved to the 216-A-36B Crib section and the 216-A-36A Crib section was no longer used. Discharge to the 216-A-36B Crib resumed in March 1966 and continued until 1972, when the crib was temporarily removed from service. The 216-A-36B Crib was placed back in service in November 1982 and operated until it was taken out of service again in October 1987.

Ammonia scrubber distillate disposed of to the A-36B Crib consisted of condensate from nuclear fuel decladding operations in which zirconium cladding was removed from irradiated fuel by boiling in a solution of ammonium fluoride and ammonium nitrate. Other waste stream constituents included the radionuclides of plutonium, tritium, uranium, ^{90}Sr, ^{137}Cs, $^{103,106}Ru$, ^{60}Co, ^{113}Sn, ^{147}Pm, ^{241}Am, and ^{129}I (Aldrich 1987).

An interim-status RCRA groundwater monitoring program has been in operation at the A-36B Crib since May 1988. The A-36B Crib is currently monitored under a detection-level program. The RCRA closure/post-closure plan for the A-36B Crib is scheduled to be submitted to the Washington State Department of Ecology (Ecology) and the U.S. Environmental Protection Agency (EPA) in June 1998. This action will satisfy the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement), Milestone M-20-34 (Ecology et al. 1994). The A-36B Crib is part of the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) 200-PO-2 operable unit.

2.2.2 216-A-10 Crib

The 216-A-10 Crib (A-10 Crib), now retired from use, was a liquid waste disposal facility for the PUREX Plant. The A-10 Crib is located in the 200 East Area approximately 122 m south of the PUREX Plant. It is approximately 110 m west of the 216-A-36B Crib (Figure 2).

The A-10 Crib is 84 m long, has a V-shaped cross section, and is 14 m deep. Several waste streams, collectively described as process distillate discharge, were disposed of to the A-10 Crib and were allowed to percolate through the soil column.

The A-10 Crib first received liquid waste over a 4-month period during the PUREX startup in 1956. In 1961, the A-10 Crib replaced the 216-A-5 Crib and received PUREX effluent continuously until 1973. Periodic discharges were received in 1977, 1978, and 1981. From 1982 to 1987, effluent discharges resumed on a continual basis. Discharge between 1981 and 1986 averaged 1×10^8 L per year. In 1987, the A-10 Crib was taken out of service and replaced by the 216-A-45 Crib.

The process distillate discharge waste stream to the A-10 Crib was characteristically acidic and contained concentrated salts. Other waste stream constituents included aliphatic hydrocarbon compounds; organic complexants; and the radionuclides tritium, plutonium, uranium, ^{90}Sr, ^{134,137}Cs, ^{103,106}Ru, ^{60}Co, ^{113}Sn, ^{147}Pm, ^{241}Am, and ^{129}I (Aldrich 1987).

An interim-status RCRA groundwater monitoring network has been active for the A-10 Crib since November 1988. The groundwater monitoring program is currently in detection-level monitoring. The RCRA closure/post-closure plan for the A-10 Crib is scheduled to be submitted to Ecology and the EPA in June 1998. This document will satisfy the Tri-Party Agreement Milestone M-20-33 (Ecology et al. 1994). The A-10 Crib is part of the CERCLA 200-PO-2 operable unit.

2.2.3 216-A-37-1 Crib

The 216-A-37-1 Crib (A-37-1 Crib), now retired from use, was a liquid waste disposal facility for the PUREX Plant. The A-37-1 Crib is located in the 200 East Area approximately 600 m east of the 202-A building (Figure 2).

The original crib dimensions were 213 m long, 3 m wide, and 3.4 m deep. A 0.25-m-diameter corrugated, galvanized, perforated distributor pipe was placed on 1 m of gravel fill. The distributor pipe was covered with gravel, a layer of plastic, and backfill material. Associated structures include two liquid level risers, a vent riser, and a diversion box. The diversion box was originally designed to receive waste via the 216-A-30 Crib. In 1976 a line was constructed from the 207-A Retention Basin to the northeast inlet of the diversion box. The southeast inlet and outlet were available to divert wastes to another crib if needed. The diversion box and inlet and outlet pipes were filled with concrete in June 1994 to eliminate any inadvertent entry of water to the waste water diversion box and the connected cribs. It should be noted that waste water entered at the southeast end of the crib, which is at a lower elevation than the northwest end. This configuration favored infiltration at the southeast end of the cribs.

The A-37-1 Crib first received liquid waste from March 1977 to April 1989. The crib received process condensate from the 242-A Evaporator. The process condensate was determined to be regulated as a mixed waste because it contained radionuclides and spent halogenated and nonhalogenated solvents and because the ammonia is toxic. The estimated annual quantity of dangerous waste of 49,120 kg represents the maximum annual output of evaporator process condensate during operating campaigns. The discharge to the A-37-1 Crib was discontinued in April 1989 and a RCRA Part A Permit Application was prepared. However, reports from subsequent site visits stated that the flow of water could be heard at the distribution box that diverted waste water to the crib. In 1994 the distribution box was permanently sealed by filling it with concrete, thus eliminating any inadvertent routing of waste water to the crib.

The process condensate discharged to the A-37-1 Crib was a low-salt alkaline solution. The major contaminants of concern based on effluent measurements are tritium, ammonium/nitrate, acetone, and hexone. Constituents of concern, based on process knowledge, but not confirmed by effluent measurements, are methylene chloride and trichloroethane. The organic constituents are not present in groundwater, however. Small quantities of fission products and transuranics were also discharged to the crib as carry over from the 242-A Evaporator. They include tritium, uranium, ^{90}Sr, ^{137}Cs, and ^{147}Pm (Aldrich 1987).

A-37-1 is one of several liquid effluent discharge sites that was excluded from the list of RCRA sites in the Tri-Party Agreement (Ecology et al. 1994). Under Milestones M-17-00A and M-17-00B of the Tri-Party Agreement, the excluded sites were the subject of a liquid effluent study to determine their environmental impact. Listed waste types were identified in the effluent stream to the A-37-1 Crib; therefore the crib was made subject to RCRA regulations. Discharge to the crib was terminated in April 1989 and a Part A RCRA permit application was submitted for the site in February 1990. Subsequent investigations indicated the potential presence of chlorinated hydrocarbon solvents from operation in B Plant and T Plant, and a revised Part A was submitted in May 1993. A second revision was submitted in June 1994 to transfer responsibility for the facility to Bechtel Hanford, Inc., the environmental restoration contractor. The facility is currently scheduled for closure under RCRA final status, and a closure plan is scheduled to be submitted to Ecology and the EPA in 2003. The A-37-1 Crib is part of the 200-PO-4 operable unit.

As noted, the crib was not included among the initial RCRA sites listed in the Tri-Party Agreement; however, it was subsequently monitored along with the non-RCRA active effluent discharge sites by the Operational Monitoring

Program (DOE-RL 1994). Some of the wells near the crib were also monitored as part of the 216-A-29 Ditch RCRA groundwater monitoring program.

3.0 HYDROGEOLOGIC SETTING OF THE 200 EAST AREA, SOUTH OF THE PUREX PLANT

This section summarizes the geologic and hydrologic features that control the direction and rate of groundwater flow and contaminant movement in the area of the A-10, A-36B, and A-37-1 Cribs (i.e, the WMA). The following descriptive material has been excerpted from recent groundwater impact assessments, groundwater monitoring plans (Kasza 1994), and other sources (Knepp et al. 1994 and Lindberg et al. 1993). The geology and hydrology of the Hanford Site and the 200 East Area are described in Delaney et al. (1991), Lindsey et al. (1992), and Connelly et al. (1992).

The Hanford Site is located in the Pasco Basin, a broad sediment-filled depression that lies within the Columbia Basin physiographic province. The Hanford Site is noted for its thick sedimentary fill, wide areal variability in groundwater and contaminant movement, relatively thick vadose zone in a temperate desert environment, and limited natural recharge to the aquifers locally.

3.1 GEOLOGY

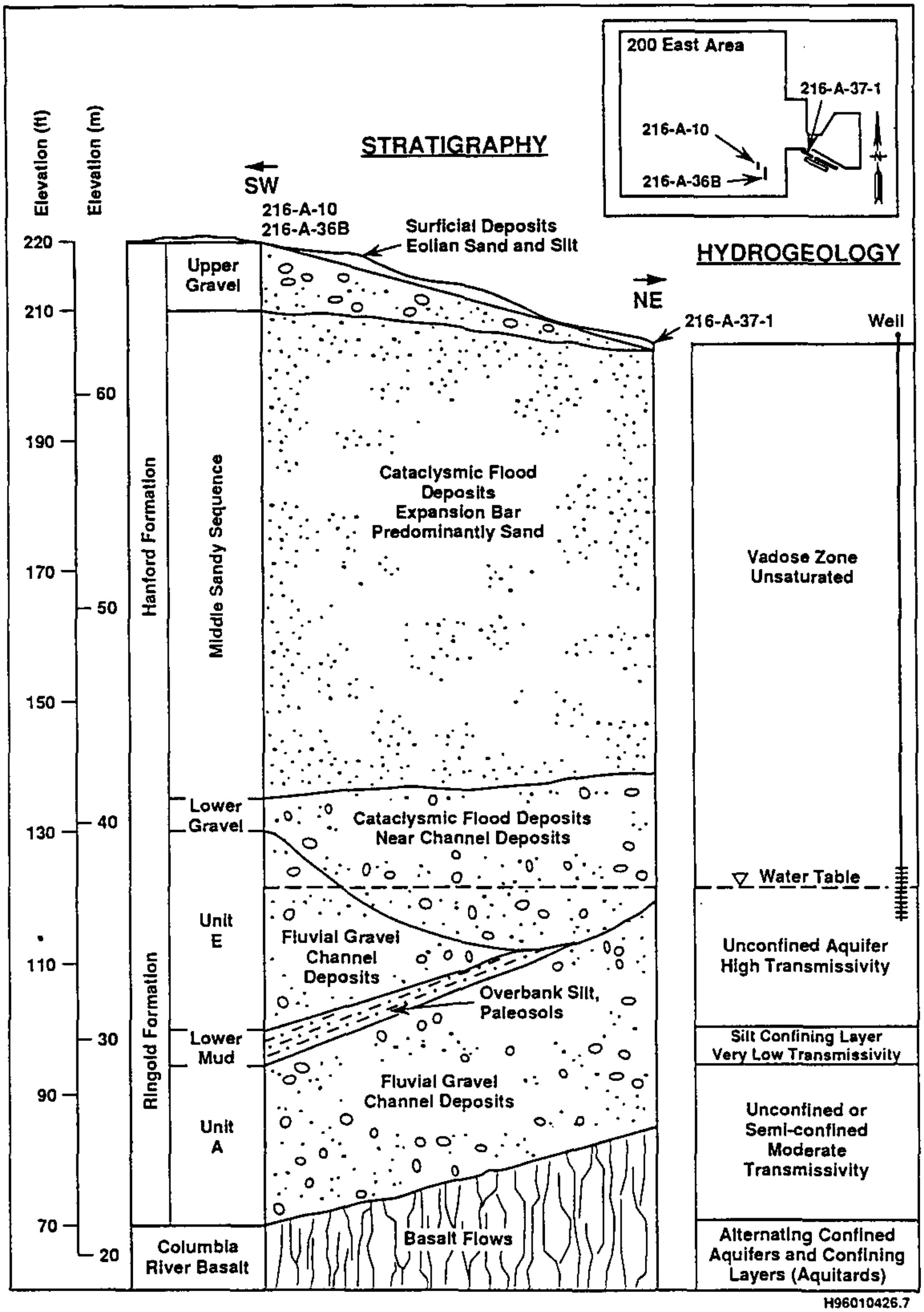
The WMA is located on the eastern side of a large flood bar (i.e., cataclysmic flooding) known as the 200 Areas Plateau. The ground surface in the network area is relatively flat, but slopes gently toward the north. Elevation of the ground surface ranges from about 220 m near the A-36B and A-10 Cribs to about 205 m near the A-37-1 Crib.

The general stratigraphy includes the following stratigraphic units (lower to upper) (see Figure 3):

- Bedrock consisting of Columbia River Basalt flows that dip gently to the south toward the axis of the Cold Creek syncline
- The fluvial Ringold Formation with thick layers of river gravel intercalated with sequences of overbank silts and fine-grained paleosols
- Cataclysmic flood deposits of the Hanford Formation consisting predominantly of sand
- A discontinuous veneer of Holocene eolian silty sand.

Although the stratigraphy at all three crib sites contains the general stratigraphic section described above, differences exist between the A-10 and A-36B Cribs area to the southwest and the area near the A-37-1 Crib to the northeast. The differences are mainly in the Ringold Formation stratigraphy (see Figure 3). To the southwest near the A-10 and A-36B Cribs, the Ringold Formation contains three mappable units including coarse-grained fluvial units A and E with the fine-grained lower mud unit separating them. However, in the vicinity of the A-37-1 Crib (northeast) the lower mud unit and unit E are

Figure 3. Hydrogeology and Stratigraphy Beneath the 216-A-10, 216-A-36B, and 216-A-37-1 Cribs.



missing. The Hanford formation rests directly on Ringold Formation unit A. (For more detail on stratigraphy in the network area and the Grout Facility see Lindberg et al. 1993).

3.2 HYDROGEOLOGY

3.2.1 Surface Water

No natural surface water bodies exist near the crib sites. However, 216-B-3 Pond is an effluent disposal site northeast of the network area. It recharges the uppermost aquifer and controls the direction of groundwater flow in the eastern portion of the network area.

3.2.2 Vadose Zone

The vadose zone in the network area comprises predominantly the middle sandy sequence of the Hanford formation. Beds containing gravel or silt are common in this sequence, but their percentages are minor compared to the large amount of sand. The vadose zone in the vicinity of the A-10 and A-36B Cribs is approximately 99 m thick; in the vicinity of the A-37-1 Crib it is about 84 m thick.

Estimates of contaminant and moisture migration rates through the vadose zone beneath the eastern portion of the crib sites (i.e., near the A-37-1 Crib) were made for the liquid effluent study (WHC 1990). Calculations suggest the following:

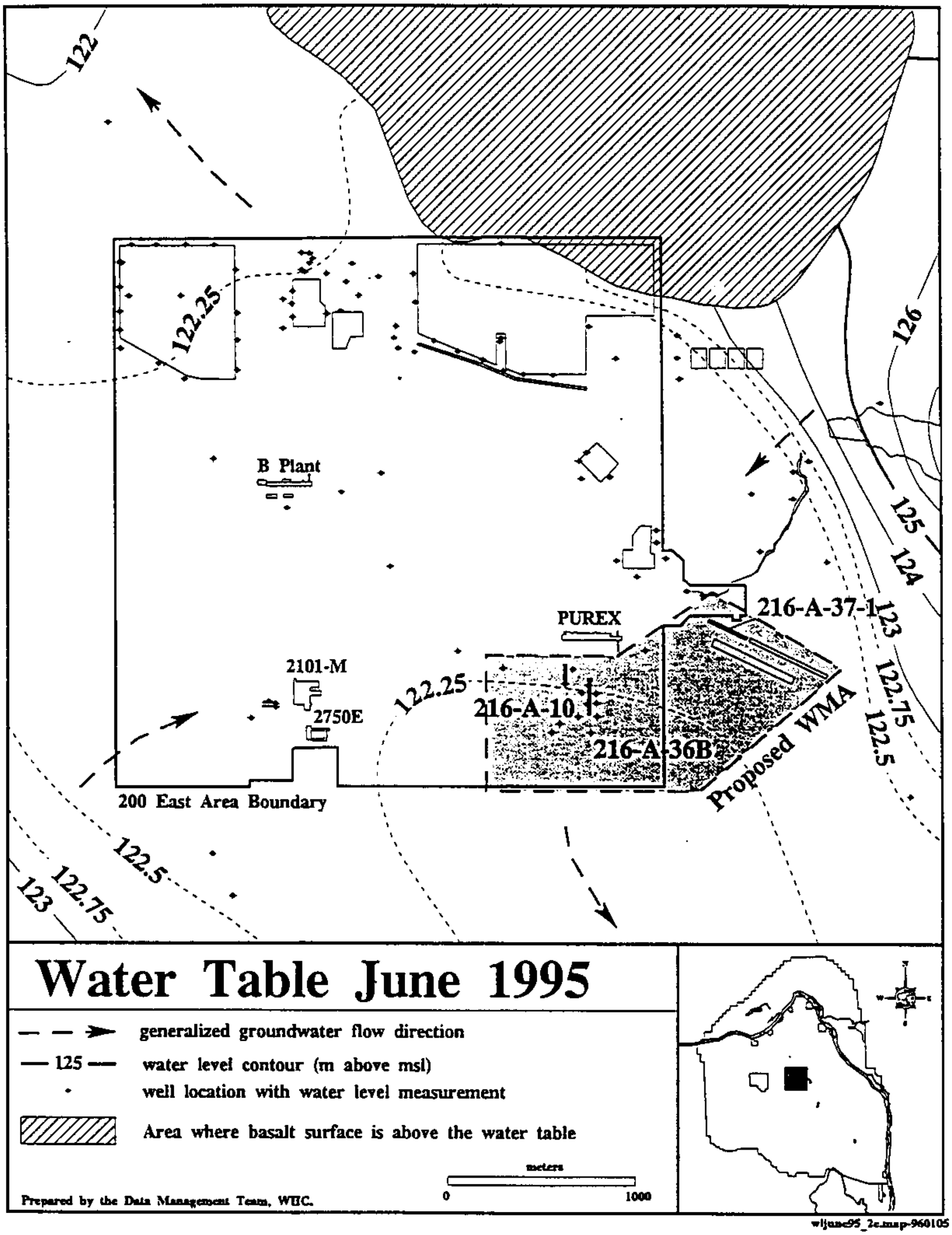
- During routine operation of the A-37-1 Crib, travel time of waste water through the vadose zone to the water table was on the order of 8 to 9 months
- Under average flow conditions the vadose zone was unsaturated (i.e., the calculated infiltration rate was less than the saturated hydraulic conductivity of the vadose zone).

Maximum depth of penetration for the relatively small quantities of ^{137}Cs and ^{90}Sr (<1 Ci) was about 40 m.

3.2.3 Hanford/Ringold Aquifer System

The aquifer in the vicinity of the cribs is either unconfined or semiconfined, depending on the presence or absence of the lower mud unit of the Ringold Formation (see Figure 3). To the southwest, near the A-10 and A-36B Cribs, the water table is within unit E of the Ringold Formation. From the water table (at approximately 122 m elev.) downward to the lower mud unit (at about 100 m elev.) the aquifer is unconfined. Below the lower mud unit the aquifer is confined or semiconfined and is about 24 m thick. However, in the northeastern part of the WMA (near the A-37-1 Crib), the water table is within the lowest portion of the Hanford formation or the upper part of the Ringold Formation unit A. The lower mud unit pinches out between the crib locations so the aquifer is unconfined to the base of the Ringold Formation at about 85 m elevation. Therefore, the thickness of the unconfined aquifer in

Figure 4. June 1995 Water Table Map of the 200 East Area.



the northeastern portion of the WMA is approximately 37 m. Wells screened at the water table in the WMA are screened entirely within unit E of the Ringold Formation in the southwest, but are screened the Hanford formation and/or unit A of the Ringold Formation on the northeastern side of the site (see Figure 3).

Groundwater flow in the WMA is interpreted to be predominantly from the northeast to the southwest (Figure 4). It is influenced by a groundwater mound beneath the 216-B-3 Pond (B Pond) where groundwater is flowing radially outward. However, in the extreme western portion of the WMA the water table gradient is generally toward the south and southeast. Groundwater from the B Pond area joins groundwater from the northwest (200 East Area) and flows toward the south and southeast.

The water table gradient in the vicinity of B Pond is much steeper than in the WMA (see Figure 4). This variation in groundwater flow is interpreted to be the result of differences in hydraulic conductivity in the upper portion of the unconfined aquifer. Finer, less transmissive sediments beneath B Pond (e.g., the Ringold Formation lower mud unit) give way to coarser, more transmissive sands and gravels to the west (Ringold Formation unit E). The water table gradient beneath the majority of the network area is very flat, making flow direction and rate difficult to estimate.

Estimates of hydraulic conductivity in the WMA range from 18 m/d (Kasza 1992) to 3,000 m/d (Connelly et al. 1992). The lower estimates are from slug tests, and the higher estimates from a hydraulic conductivity map constructed from compiled data (Connelly et al. 1992). Results of a pumping test at the Grout Facility indicate hydraulic conductivity at 305 m/d (Swanson 1994).

The exact amount of natural recharge of the uppermost aquifer within the network area is unknown, but it is insignificant compared to liquid disposal activities. Recharge in the vicinity is affected by soil type, vegetation, and weather. Fayer and Walters (1995) estimated that recharge could be less than 1 mm/yr for sandy loam with bunchgrass to 85 mm/yr for the same soil without vegetation. Portions of the WMA where a great deal of human activity has occurred have sparse vegetation that may allow a significant amount of recharge.

4.0 GROUNDWATER QUALITY

This section lists the contaminants of concern and contains contaminant plume maps. A primary objective is to correlate contaminant spatial and temporal distribution patterns in the 200 East Area with historical discharges.

4.1 SPECIFIC CONDUCTANCE

A general indication of B Pond water movement and chemical contaminant distribution is illustrated with the specific conductance map for the 200 East Area (Figure 5). Specific conductance is one of four RCRA contaminant indicator parameters and a key to understanding impacts of chemicals in the

Figure 5. Specific Conductance in the Uppermost Aquifer, 200 East Area.

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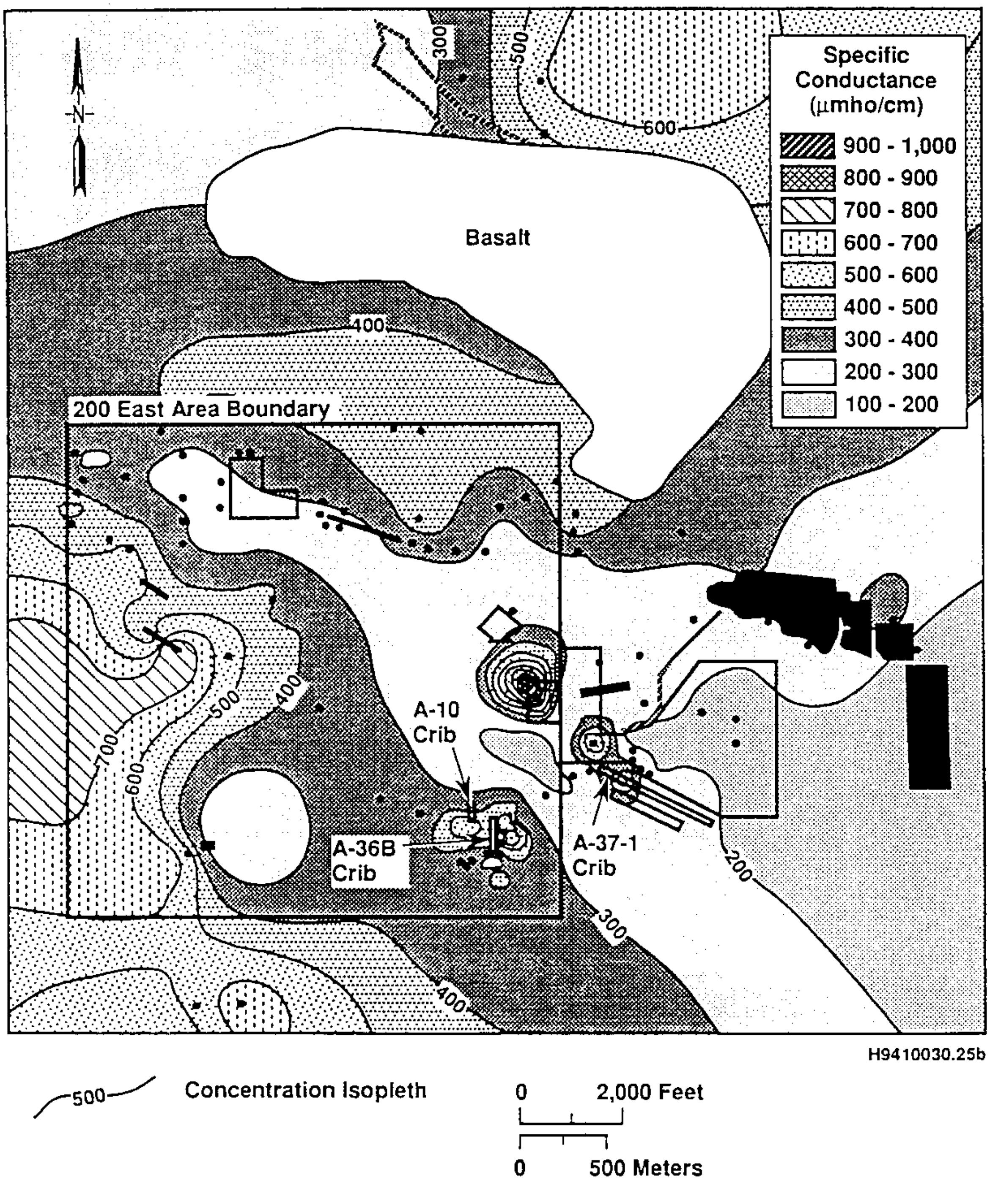


proposed WMA. Specific conductance of ambient groundwater is about 350-400 μmho/cm compared to about 140 μmho/cm for cooling water discharged to B Pond. Thus, specific conductance of groundwater decreases as it mixes with waste water from B Pond. Smaller areas of elevated specific conductance are superimposed on this general pattern in the vicinity of the A-10, A-36B, A-37-1 Cribs. The A-29 Ditch was one source of elevated specific conductance. The head (southwest) end of the ditch received chloride- and sulfate-containing chemical waste associated with demineralizer regeneration. Two of the wells adjacent to the A-37-1 Crib also have slightly elevated conductivity, although evaporator condensate discharged to the crib had relatively low specific conductance (80-400 μmho/cm).

4.2 ARSENIC

The arsenic plume (Figure 6) coincides with the general trend exhibited by the specific conductance. The source of the arsenic may be past discharges of chemical waste in which arsenic was present as a cocontaminant (e.g., the 216-A-29 Ditch) or associated with chemical carry over from the 242-A Evaporator wastes discharged to the A-37-1 Crib. The large arsenic plume also includes the area in the vicinity of the A-10 and A-36B Cribs. Although no direct evidence shows that the southwest extension of the plume is caused by discharges to the A-10 and A-36B Cribs, arsenic-contaminated waste water is known to have been discharged to these cribs.

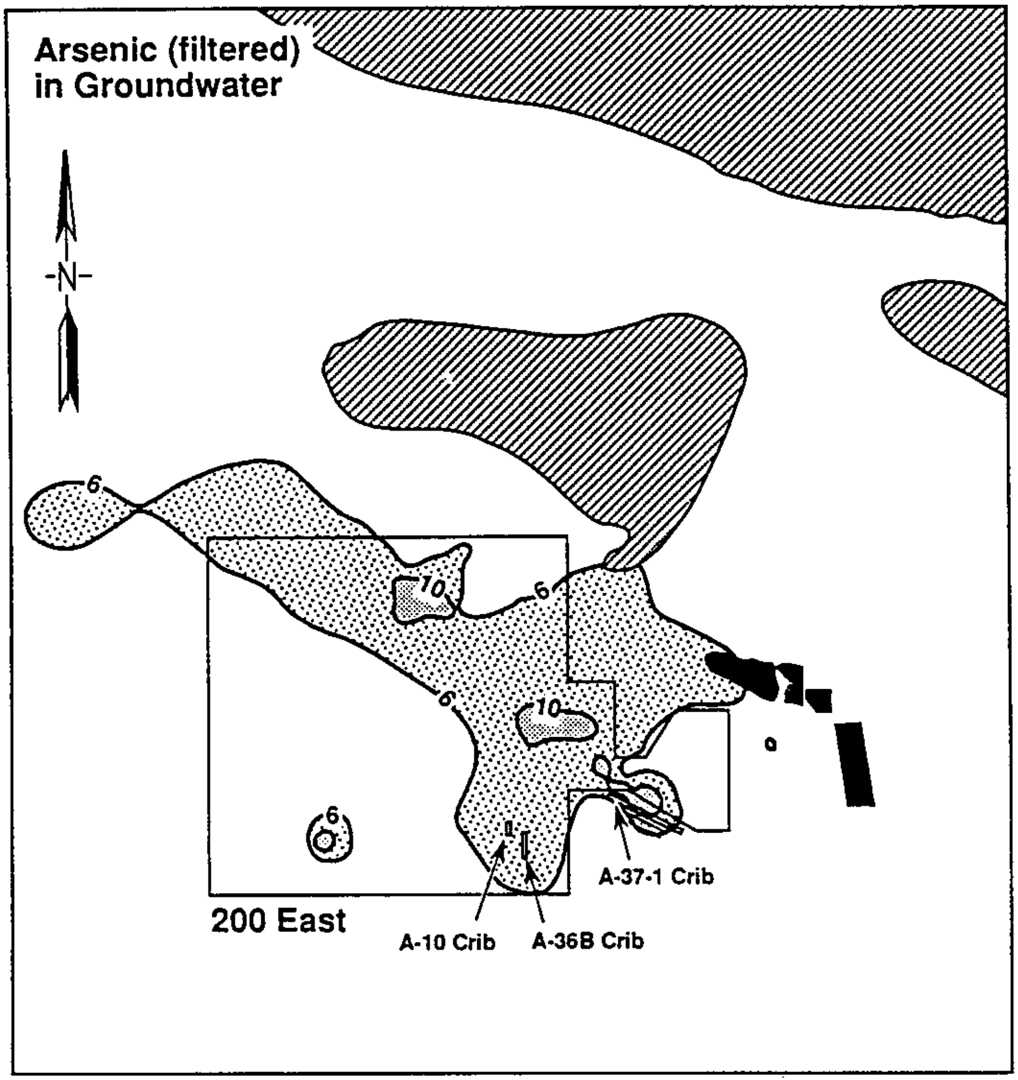
4.3 NITRATE

A concentrated nitrate plume is centered on the A-37-1 Crib (Figure 7). The nitrate concentration is higher than the drinking water standard (45,000 ppb) in two wells adjacent to the A-37-1 Crib. Recharge from B Pond has decreased nitrate concentrations in the aquifer in the surrounding area. However, wells in the immediate vicinity of the A-10 and A-36B Cribs show nitrate concentrations that are slightly higher than surrounding wells in the nitrate plume. This increased concentration in the vicinity of the cribs may indicate that A-10 and/or A-36B is a source of nitrate contamination. This plume extends diagonally northwest to southeast beneath the 200 East Area and has virtually the same preferential flow path as tritium.

4.4 TRITIUM

Tritium contamination extends diagonally from northwest to southeast beneath the 200 East Area (Figure 8). The highest average concentrations are found in the southeast corner of the area in wells monitoring disposal facilities associated with the PUREX Plant and the 242-A Evaporator. The drinking water standard (20,000 pCi/L) is exceeded in wells adjacent to the A-10, A-36B, and A-37-1 Cribs and some of the other wells nearby.

Figure 6. Arsenic in the Uppermost Aquifer, 200 East Area.



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6 Concentration Isopleth (ppb)

Concentration values shown are average values for the period 1/1/91 - 10/1/93

Detection Limit	5 ppb
Drinking Water Standard	50 ppb
Maximum Concentration Limit	50 ppb
1/25 Derived Concentration Guide	N/A

Basalt

0 3,000 Feet

0 1,000 Meters

Figure 7. Nitrate in the Uppermost Aquifer, 200 East Area.

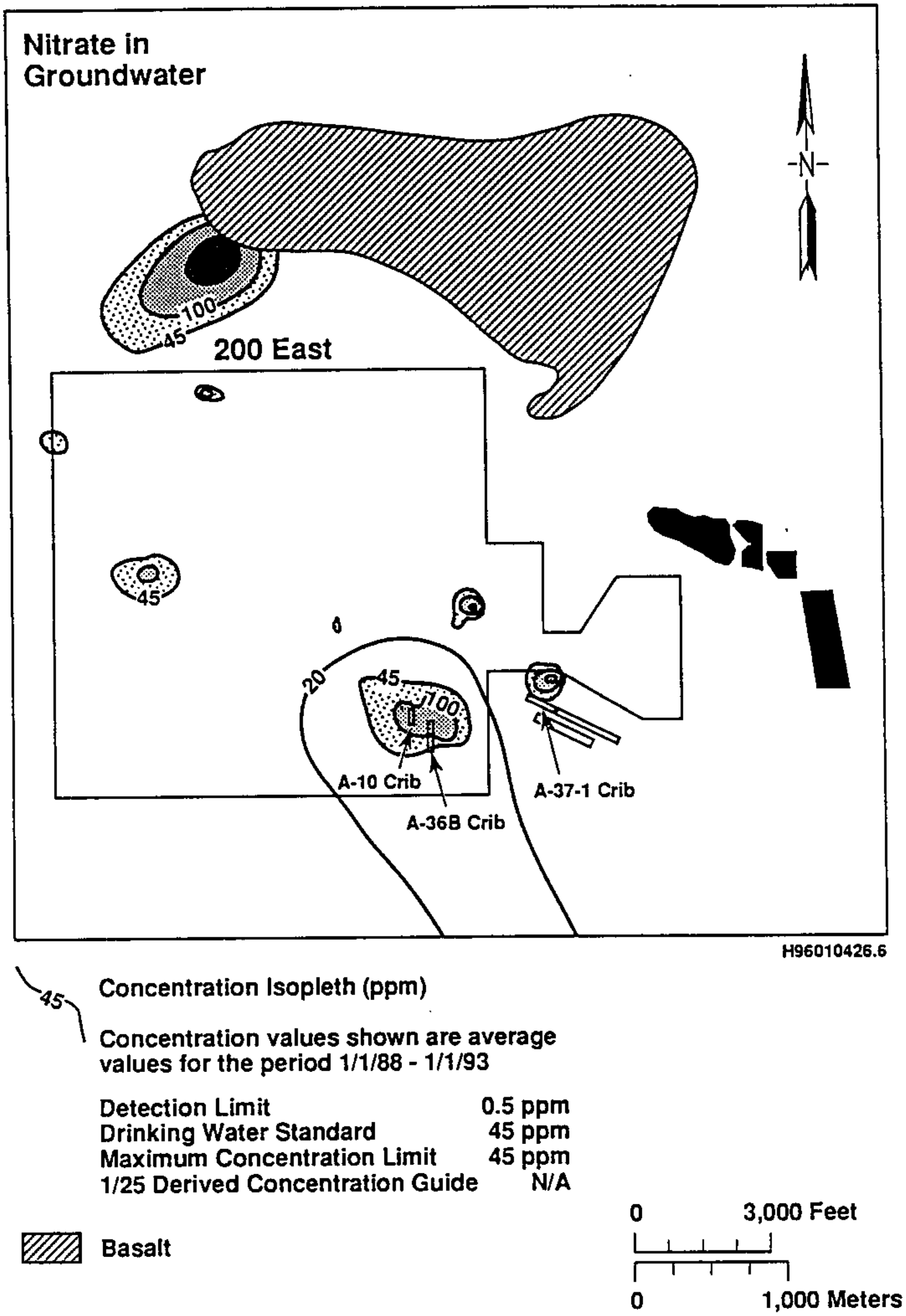
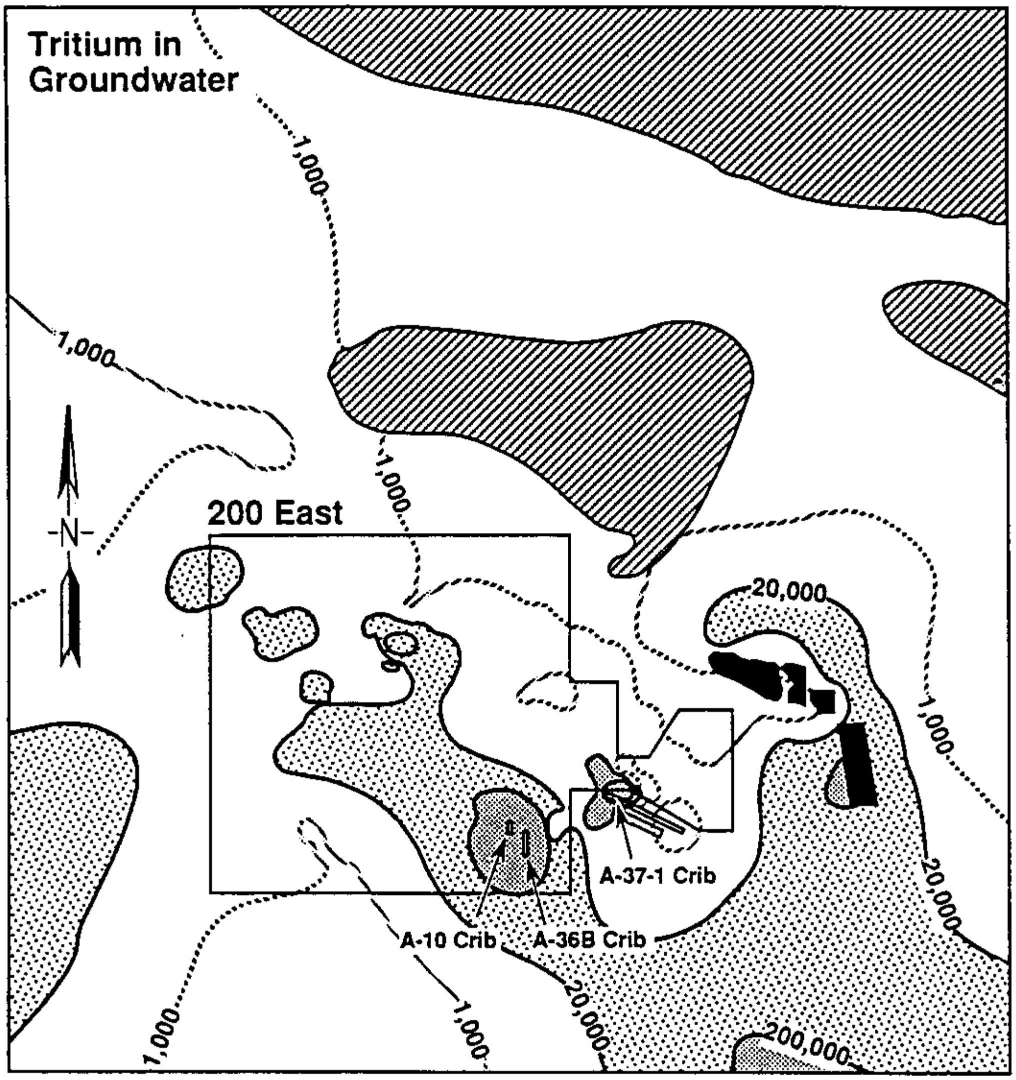


Figure 8. Tritium in the Uppermost Aquifer, 200 East Area.



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1,000 Concentration Isopleth (pCi/L)

Concentration values shown are average values for the period 1/1/91 - 10/1/93

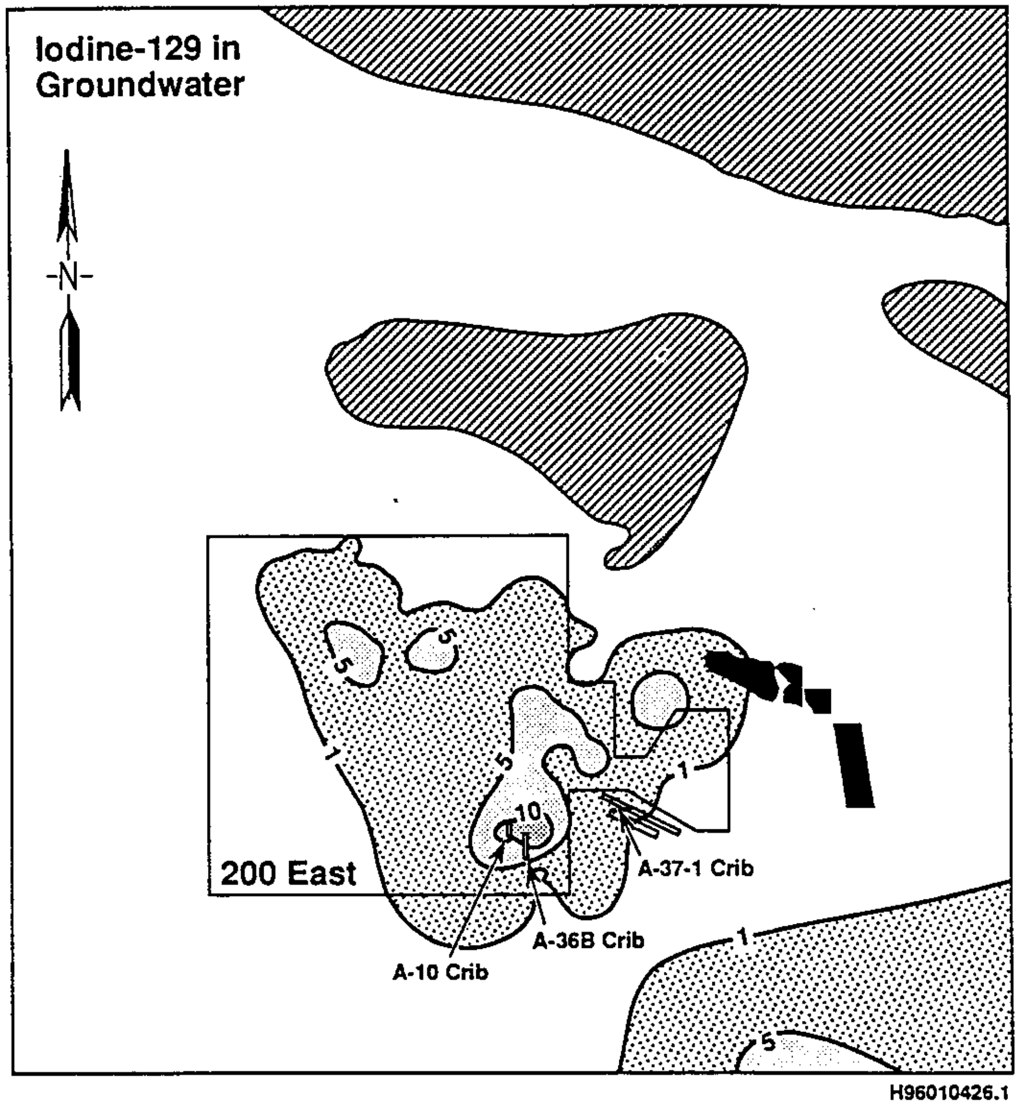
Detection Limit	500 pCi/L
Drinking Water Standard	20,000 pCi/L
Maximum Concentration Limit	20,000 pCi/L
1/25 Derived Concentration Guide	80,000 pCi/L

Basalt

0 3,000 Feet

0 1,000 Meters

Figure 9. Iodine-129 in the Uppermost Aquifer, 200 East Area.



1 Concentration Isopleth (pCi/L)

Concentration values shown are average values for the period 1/1/91 - 10/1/93

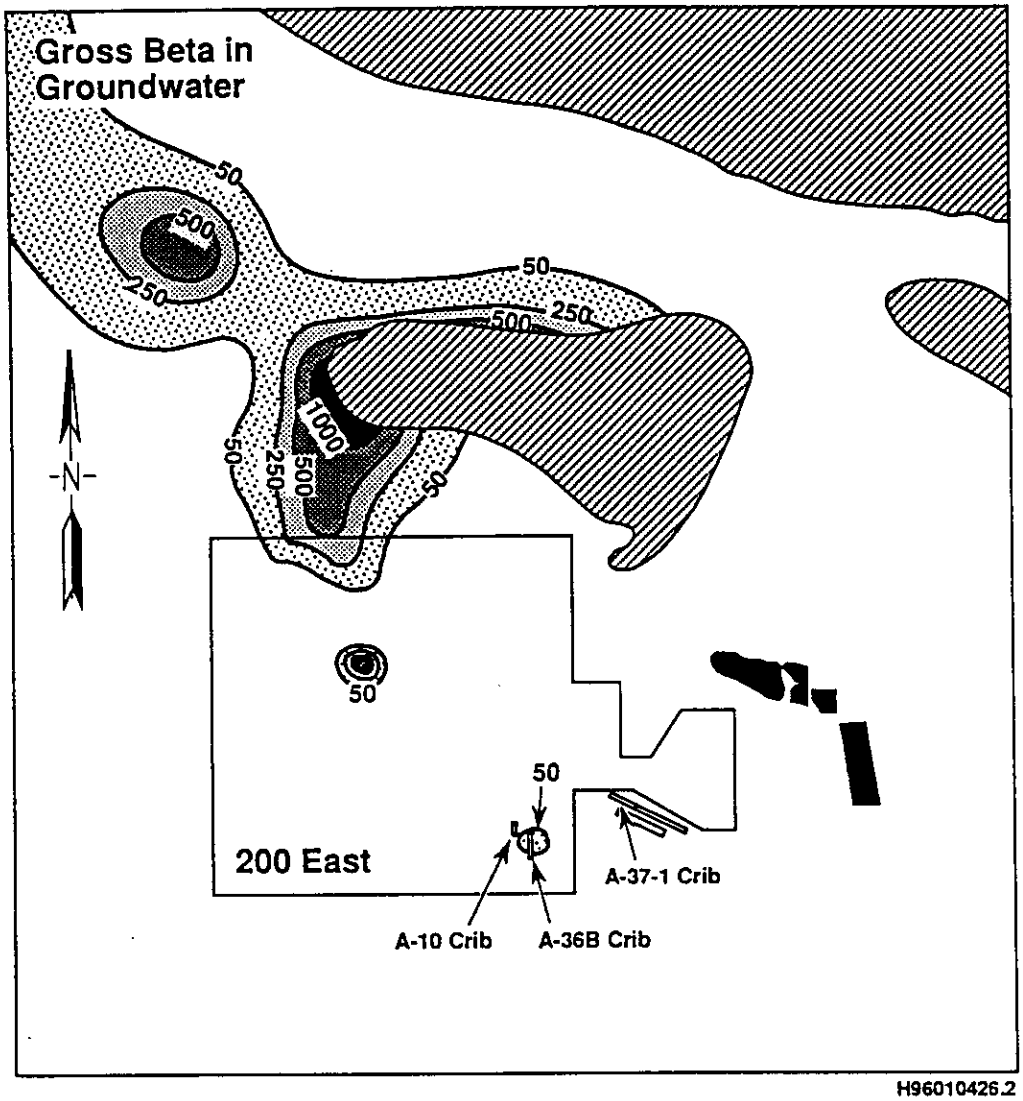
Detection Limit	1 pCi/L
Drinking Water Standard	1 pCi/L
Maximum Concentration Limit	1 pCi/L
1/25 Derived Concentration Guide	20 pCi/L

0 3,000 Feet

0 1,000 Meters

Basalt

Figure 10. Gross Beta in the Uppermost Aquifer, 200 East Area.



50 Concentration Isopleth (pCi/L)

Concentration values shown are average values for the period 1/1/91 - 10/1/93

Detection Limit	4 pCi/L
Drinking Water Standard	50 pCi/L
Maximum Concentration Limit	N/A
1/25 Derived Concentration Guide	N/A

Basalt

0 3,000 Feet

0 1,000 Meters

4.5 IODINE-129

Nearly the entire central portion of 200 East Area is underlain by ^{129}I-contaminated groundwater (Figure 9). The highest average concentration (>5 pCi/L) is found in wells in the southeastern corner of the area. The primary source is PUREX process condensate previously discharged to the A-10 and 216-A-45 Cribs. Evaporator condensate discharged to the A-37-1 Crib may also have contributed to the widely dispersed plume that remains today.

4.6 BETA-EMITTING RADIONUCLIDES

The general distribution of beta-emitting radionuclides is presented in Figure 10. The largest beta plume in the 200 East Area extends north from the 200 East Area. A small plume occurs in the southeast corner in wells that monitor the A-10 and A-36B Cribs. ^{99}Tc and ^{90}Sr are the primary contributors to the beta plume. Gross beta activity is not elevated near the A-37-1 Crib.

5.0 RECOMMENDED MONITORING NETWORK AND CONSTITUENT LIST

The objective of the proposed monitoring program is to monitor the contaminants of concern that have migrated from the three RCRA facilities (A-36B, A-10, and A-37-1) and determine the nature, rate, and extent of this contamination (see Figure 2) within the WMA. Data from PNNL's sitewide program will be used to help further determine the full extent of the plumes. The monitoring program also will evaluate common contaminants from non-RCRA facilities in the WMA because the source of the contamination cannot be precisely determined.

The proposed monitoring network will include approximately 10 existing monitoring wells and 1 new well instead of 23 unit-specific wells. The proposed network will reduce the redundancy associated with a unit-specific monitoring approach, while complying with the intent of RCRA regulations. At the Hanford Site, where each plant operates multiple RCRA treatment, storage, and disposal units (TSD), unit-specific monitoring minimizes the ability to interpret groundwater data and understand groundwater impacts imposed by the whole waste disposal complex consisting of many interrelated TSDs. Another unique feature of RCRA facilities at the Hanford Site is that these facilities remain in interim-status detection monitoring, yet no longer receive effluent. The groundwater impacts from their disposal activities have been determined and are known. The unit-specific approach restricts the ability to accurately evaluate the impacts, groundwater flow conditions, and contaminant migration. The groundwater gradient is so low in the proposed WMA that unit-specific monitoring networks do not provide the areal coverage necessary to allow an accurate determination of the groundwater flow direction).

A preliminary cost-benefit analysis indicates that one combined monitoring network would cost only one-third as much as three site-specific networks (Table 2).

Table 2. Cost-Benefit Analysis.

	Three Separate Networks (current)	One Network (proposed)	Cost Savings (%)
Sampling (1 yr)	~$110,000	~$45,000	60
Drilling	~$450,000 (3 wells)[a]	~$150,000 (1 well)	67
Total	~$560,000	~$195,000	65

[a]The draft groundwater monitoring plan for the A-37-1 Crib proposed to drill three new wells.

The proposed network will monitor the groundwater following Interim-status assessment requirements [40 *Code of Federal Regulations* (CFR) 265.90(d)]. These regulations state:

> *(d) If an owner or operator assumes (or knows) that ground-water monitoring of indicator parameters in accordance with §§ 265.91(b) and 265.92 would show statistically significant increases (or decreases in the case of pH) when evaluated under § 265.93(b), he may, install, operate, and maintain an alternate ground-water monitoring system (other than the one described in §§ 265.91 and 265.92). If the owner or operator decides to use an alternate ground-water monitoring system he must:*
>
> > *(1) Within one year after the effective date of these regulations, submit to the Regional Administrator a specific plan, certified by a qualified geologist or geotechnical engineer, which satisfies the requirements of § 265.93(d)(3) (i.e. assessment monitoring), for an alternate ground-water monitoring system;*
> >
> > *(2) Not later than one year after the effective date of these regulations, initiate the determinations specified in § 265.93(d)(4)(i.e. rate, extent, and concentrations of waste constituents);*
> >
> > *(3) Prepare and submit a written report in accordance with § 265.93(d)(5);*
> >
> > *(4) Continue to make the determinations specified in § 265.93(d)(4) on a quarterly basis until final closure of the facility; and*
> >
> > *(5) Comply with the record keeping and reporting requirements in § 265.94(b). (i.e. results of assessment)*

The A-10 and A-36B cribs are currently monitored under a detection-level program. However, as discussed in Section 4, the groundwater quality has been affected by the effluent disposed of at the A-10, A-36B, and A-37-1 Cribs.

Nitrate, arsenic, ^{90}Sr, ^{129}I, and tritium exceed the primary drinking water standards in at least some of the wells near the cribs. The A-37-1 Crib has not been monitored as a RCRA site in the past, but data from wells adjacent to the crib show that it also has affected groundwater (see Section 4). An assessment monitoring program, which will determine the nature, extent, and rate of groundwater contamination, is appropriate for the A-10, A-36B, and A-37-1 Cribs. The proposed monitoring program is technically supported and meets the intent of the regulations more closely than individual TSD unit-specific detection monitoring programs.

5.1 MONITORING NETWORK

The proposed monitoring network will include approximately 10 existing monitoring wells and 1 new well. Figure 2 and Table 3 show preliminary choices for the network. Figure 11 shows the existing wells in the area. The wells were chosen for their location, well design, and concentration history. The selection of appropriate monitoring well locations (new and existing) will depend on adequate spacial coverage to define the existing contaminant plumes. Well design and condition must be evaluated to ensure that the well yields representative data (e.g. casing materials, screened depth, and annular seals may affect groundwater data). Wells with historical chemistry data will be evaluated and selected over those with less data so that trending analysis can be used to delineate contaminant migration and determine appropriate sampling frequencies. Wells with greater data variability will be considered over wells with unchanging or minimal data.

One new well will be required to fill data gaps. These data gaps include a lack of spacial coverage in the southern portion of the WMA, undefined aquifer boundaries, and unknown vertical contaminant distribution. The area where groundwater flows southeast and out of the proposed WMA has no well control and represents a major preferential pathway for all groundwater contaminants migrating south of the 200 East Area. Existing well data south of the WMA is very limited and provides minimal data for interpreting aquifer conditions and control mechanisms. The well will be drilled to basalt (~400 ft below land surface) and backfilled to be completed as a shallow well in the upper aquifer (290 ft below land surface).

The sampling frequency will be proposed pending the results of data evaluation including variability and concentration trend analyses.

Table 3. Proposed Groundwater Monitoring Network for the A-36B, A-10, and A-37-1 Cribs.

E17-1
E17-14
E17-18
E17-19
E24-18
E25-12
E25-19
E25-31
E25-44
E25-36
New Well [south central portion of WMA (exact location TBD)]

5.2 CONSTITUENT LIST

Previous monitoring of the RCRA and other facilities associated with PUREX effluent disposal has allowed a thorough investigation and identification of contaminants affecting the aquifer. Based on 8 years of groundwater sampling, including a complete appendix IX evaluation at the A-10 and A-36B Cribs, the assessment network will be sampled for pH, specific conductance, turbidity, alkalinity, arsenic, nitrate, ammonium, gross beta, tritium, ^{129}I, ICP metals, and anions (Table 4). Phenols will not be included as a groundwater quality parameter because process knowledge indicates that phenols were not added to the subject cribs. This is confirmed by the fact that phenols have never been detected in groundwater samples. Water level measurements will be collected at least once during sampling activities.

6.0 CONCLUSIONS

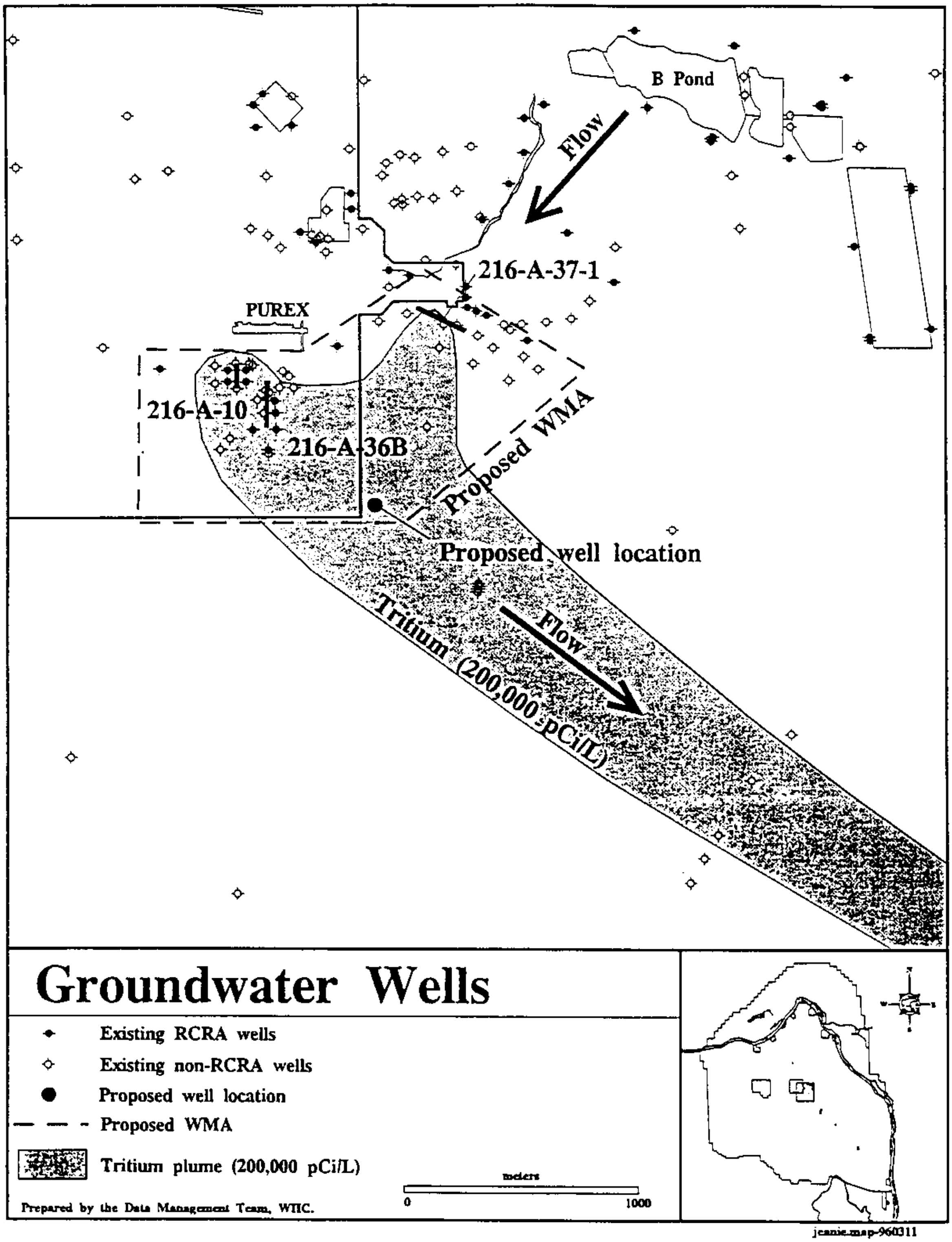
Consolidating the A-10, A-36B, and A-37-1 under one RCRA groundwater monitoring program is the most appropriate and recommended approach to groundwater monitoring in this area. It will provide improved data results for meeting RCRA regulatory requirements, meet the needs of the DOE, Richland Operations Office and other groundwater programs at the Hanford Site, and save approximately $365,000 in the first year.

It is recommended that a combined groundwater monitoring plan for the three sites be completed. This plan, as required under RCRA will implement the groundwater program and define the groundwater well network, the assessment sampling and analysis plan, and reporting requirements.

Table 4. Proposed constituent list for the A-10, A-36B, and A-37-1 Cribs.

Constituent	Comments
pH (field)	Required to determine when purge is complete.
Specific conductance (field)	Required to determine when purge is complete.
Turbidity (field)	Low turbidity required for data quality.
ICP metals	Used for data checks (e.g. charge balance).
Anions	Includes a site specific constituent (nitrate).
Alkalinity	Used for charge balance.
Arsenic (filtered)	Site-specific.
Ammonium	Site-specific.
Gross beta	Site-specific.
Tritium	Site-specific.
^{129}I	Site-specific.

Figure 11. Existing Wells in and Near the 200 East Area.



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